ACKERMAN STEERING SYSTEM USED IN SOLAR CAR

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Abstract - The basic aim of our steering System is to ensure that the wheels are pointing in the desired directions. This is typically achieved by a series of linkages, rods, pivots and gears. One of the fundamental concepts is that of caster angle each wheel is steered with a pivot point ahead of the wheel; this makes the steering tend to be self-centring towards the direction of travel. The steering system must provide control over the direction of travel of the vehicle; good manoeuvrability for parking the vehicle; smooth recovery from turns, as the driver releases the steering wheel; and minimum transmission of road shocks from the road surface. The steering system provides control over direction of travel, good manoeuvrability, smooth recovery from turns, and minimum transmission of road shocks.

Keywords - Rack and pinion mechanism, steering ratio, steering effort, turning radius

1. INTRODUCTION

The most conventional steering arrangement is to turn the front wheels using a hand Operated steering wheel which is positioned in front of the driver, via the steering column, which may contain universal joints to allow it to deviate somewhat from a straight line. Other arrangements are sometimes found on different types of vehicles, for example, a tiller or rear-wheel steering. Tracked vehicles such as bulldozers and tanks usually employ differential steering that is, the tracks are made to move at different speeds or even in opposite directions, using clutches and brakes, to bring about a change of course or direction. The direction of motion of a motor vehicle is controlled by a steering system. A rack-and-pinion steering system has a steering wheel, a main-shaft, universal joints, and an intermediate shaft. When the steering is turned, movement is transferred by the shafts to the pinion. The pinion is meshed with the teeth of the rack, so pinion rotation moves the rack from side to side. This type of steering is used on passenger vehicles because it is light, and direct. This steering system has worm gearing. It provides a gear reduction, and a 90-degree change in direction. It has more parts and joints than the rack type, but it is more robust, and may be used on heavier vehicles. To allow heavy transport vehicles to carry extra weight, two steering axles may be used. They're connected by a link to common steering box.

2. LITERATURE REVIEW

Study and analysis of a modified steering system according to the constraints the objective of steering system is to provide max directional control of the vehicle and provide easy manoeuvrability of the vehicle in all type of turns with appreciable safety and minimum effort. Typical target for a solar vehicle designer is to try and achieve the minimum turning radius so that the given feature aids while manoeuvring in narrow tracks, also important for such a vehicle for driver's effort is minimum. This is achieved by selecting a proper steering system. The next factor to take into consideration deals with the response from the road. The response from the road must be optimum such that the driver gets a suitable feel of the road but at the same time the handling is not affected due to jerks. Lastly the effect of steering system parameters on other system like the suspension system should not be adverse.

3. METHODOLOGY

The steering ratio: Itis the amount of degrees you have to turn the steering wheel, for the wheels to turn an amount of degrees. In motorcycles and bicycles, the steering ratio is always 1:1, because the steering wheel will always follow the wheel. X: Y means that you have to turn the steering wheel x degree(s), for the wheel(s) to turn y degree(s). In passenger cars, the ratio is between 12:1 and 20:1.

Example: If one complete turn of the steering wheel, 360degrees, causes the wheels to turn 24 degrees, the ratio is then 360:24 = 15:1 (360/24=15).

The condition for perfect steering is that all the four wheels must turn about the same instantaneous centre. While negotiating a curve, the inner wheel makes a larger turning angle θ than the angle φ subtended by the axis of the outer wheel. Condition for perfect steering is;

$$\therefore Cot\emptyset - Cot\theta = \frac{w}{L}$$

3.1. MECHANISM

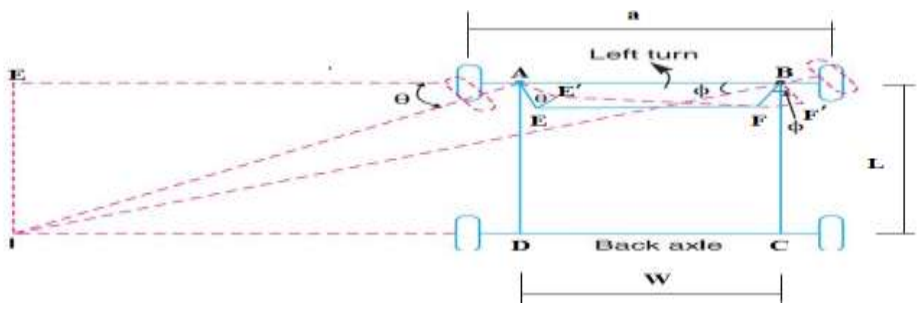

Fig: 3.1. Ackerman steering basic Geometry

In this project we have incorporated Ackerman steering mechanism which consist all the four links having turning pairs. As turning pair have less friction which reduces steering effort. With the help of this mechanism we can steer the front wheel smooth.
Wheel base- 58 inch
Track width- 42 inch
Distance between c clamps- 31 inches
Steer angles- Inner-44 degree; Outer- 34 degree
Calculated Radius- Inner wheels- 80.62 inch (2015.7 mm); Outer wheels- 104.56 inch (2614.0 mm)

3.2. CALCULATIONS

Steering effort: -
1) Radius of Steering Wheel =132mm
2) Weight on each wheel =56 kg
=56×9.81
=549.36 N
3) Torque = F×R
= 549.36×132
= 7416.36 N-mm
4) Torque = Steering effort ×Radius of wheel
∴ 7416.36 =Steering effort ×132mm
∴ Steering effort = 56.18N
Angles, inner and outer Radius: -
Turning angle of Inner Wheels = 44 °
Turning angle of Outer Wheels = $tan\emptyset = \frac{x}{y} = \frac{58}{60+42}$
$\therefore \emptyset = 29.31°$

Inner turning radius(x) = 83 inch
Outer turning radius(y) =120 inch
$\therefore x^2 = 58^2 + 60^2$
$\therefore x = 83inch$
$\therefore y^2 = 58^2 + 106^2$
$\therefore y = 120inch$

Tractive Force is given by
$F = \mu R = \mu mg = \mu \times 56 \times 9.81[\mu = 0.5]$
$= \mu \times 549.36$
$= 0.5 \times 549.36 = 274.68N$
This force is known as total force need to steer the vehicle.
So, on an average force need to steer a wheel = $F/2 = 274.68/2$
∴ F= 137.37 N

4. RESULS AND DISUSSION

Table no: 4.1 Steering Geometry

Sr. No.	Parameters	Values
1.	Steering Geometry	Ackerman
2.	Steering Ratio	1:8
3.	Camber	0°
4.	Caster	6°
5.	Toe-in	0°
6.	Toe-out	0°
7.	Steering Effort	56.18N
8.	Steer Angle	Inner- 44° Outer-34°
9.	Max Turning Radius	3.048m
10	Kingpin inclination	10°

5. CONCLUSION REMARK

The traditional advantage of these systems is that it gives bigger mechanical advantage and thus works well on heavier vehicles. In the earlier normal steering like the other steering system required more effort, by implementing Ackerman steering system we can illuminate this problem. In this linkage are replaced by rack and pinion assembly as shown above so that we save some money as well as factor of safety also increases due to the rigid assembly of rack and pinion, less joints which save assembling time of the vehicle and also attain some technical benefits like; Normally the turning radius goes to 4.3 which has been reduced to 3.048 m, and lock to lock turning of handle bar becomes 0 .35 turns.

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